

Name: _____
 Period: _____ Date: _____

Calorimetry Practice #3

Solve the following problems. As always, include work on separate sheet and show the units to ensure full credit. You will need to turn this in at the end of the period

$$q_{\text{sur}} = m \times C \times \Delta T$$

q = heat m = mass

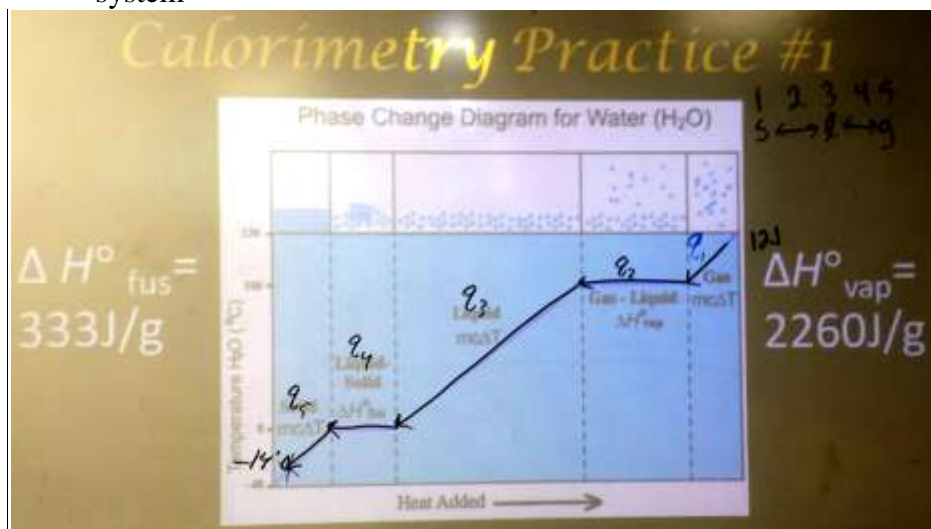
$$q_{\text{rxn}} = -q_{\text{sur}}$$

$$\Delta T = T_f - T_i$$

C = specific heat (for water = 4.184 J/g°C)

Metal	Specific Heat J/g°C
Water	4.184
ice	2.092
steam	2.008
Al	0.91
NaCl	50.52
Hg	27.29
Cu	0.39
Au	0.13
Fe	0.46
Ag	0.23
Sn	0.21
Pb	0.16

1. A 445 g sample of ice at -58°C is heated until its temperature reaches -29°C . Find the change in heat content of the system.
2. A 152 g sample of ice at -37°C is heated until it turns into liquid water at 0°C . Find the change in heat content of the system.
3. A 218 g sample of steam at 121°C is cooled to ice at -14°C . Find the change in heat content of the system



$$q_{\text{total}} = q_1 + q_2 + q_3 + q_4 + q_5$$

gas H_2O $121^\circ\text{C} \rightarrow 100^\circ\text{C} : q_1$	$= m_{\text{H}_2\text{O}} \cdot \Delta T_{\text{gas}} \cdot C_{p_{\text{gas}}} = (218\text{g})(100 - 121^\circ\text{C})(2.02\frac{\text{J}}{\text{g}^\circ\text{C}})$	$= -9192\text{J}$
$g \rightarrow l$ phase change	$: q_2 = m_{\text{H}_2\text{O}} (-\Delta H_{\text{vap}}) = (218\text{g})(-2260\frac{\text{J}}{\text{g}})$	$= -492680\text{J}$
liquid H_2O $100^\circ\text{C} \rightarrow 0^\circ\text{C} : q_3$	$= m_{\text{H}_2\text{O}} \cdot \Delta T_{\text{liquid}} \cdot C_{p_{\text{liquid}}} = (218\text{g})(0 - 100^\circ\text{C})(4.184\frac{\text{J}}{\text{g}^\circ\text{C}})$	$= -91211\text{J}$
$l \rightarrow s$ phase change	$: q_4 = m_{\text{H}_2\text{O}} (-\Delta H_{\text{fus}}) = (218\text{g})(-333\frac{\text{J}}{\text{g}})$	$= -72594\text{J}$
solid H_2O $0^\circ\text{C} \rightarrow -14^\circ\text{C} : q_5$	$= m_{\text{H}_2\text{O}} \cdot \Delta T_{\text{solid}} \cdot C_{p_{\text{solid}}} = (218\text{g})(-14 - 0^\circ\text{C})(2.09\frac{\text{J}}{\text{g}^\circ\text{C}})$	$= -6384\text{J}$

Sum of $q_1 \rightarrow q_5 = q_{\text{total}}$

- If 161 g of water at 85°C is cooled to ice at 0°C , find the change in heat content of the system.
- A 79 g sample of water at 21°C is heated until it becomes steam with a temperature of 143°C . Find the change in heat content of the system.
- If a 348 g sample of steam at 127°C is cooled to 103°C , find the change in heat content of the system.
- In going from ice at -34°C to steam at 138°C , a sample of water absorbs $1.41 \times 10^5 \text{ J}$. Find the mass of the sample.

Find the energy change of the system required to change...

- ...150 g of ice at -15°C to ice at -63°C .
- ...200 g of water at 4°C to water at 88°C .
- ...54 g of steam at 150°C to steam at 112°C .
- ...18 g of water at 0°C to ice at 0°C .
- ...215 g of water at 100°C to steam at 100°C .

13. ...44 g of ice at -13°C to water at 58°C .
14. ...330 g of steam at 100°C to ice at 0°C .
15. ...1200 g of steam at 118°C to water at 100°C .
16. ...60 g of water at 43°C to steam at 140°C .
17. ...400 g of ice at -38°C to steam at 160°C .

Answers:

1. $2.68 \times 10^4 \text{ J}$ 2. $6.23 \times 10^4 \text{ J}$ 3. $-6.71 \times 10^5 \text{ J}$ 4. $-1.11 \times 10^5 \text{ J}$ 5. $2.11 \times 10^5 \text{ J}$ 6. $-1.71 \times 10^4 \text{ J}$
7. 44.7g 8. $-1.50 \times 10^4 \text{ J}$ 9. $7.02 \times 10^4 \text{ J}$ 10. $-4.19 \times 10^3 \text{ J}$ 11. $-5.99 \times 10^3 \text{ J}$ 12. $4.85 \times 10^5 \text{ J}$
13. $2.65 \times 10^4 \text{ J}$ 14. $-9.92 \times 10^5 \text{ J}$ 15. $-2.75 \times 10^6 \text{ J}$ 16. $1.55 \times 10^5 \text{ J}$ 17. $1.28 \times 10^6 \text{ J}$